«УТВЕРЖДАЮ»
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ПРОГРАММА ВСТУПИТЕЛЬНОГО ИСПЫТАНИЯ ПО ВСТРОЕННЫМ СИСТЕМАМ (EXAMINATION PROGRAM IN EMBEDDED SYSTEMS)

для поступающих на обучение по образовательным программам высшего образования – программам магистратуры на базе программ бакалавриата и специалитета

Санкт-Петербург 2026

EXAMINATION PROGRAM IN EMBEDDED SYSTEMS
for applicants to study in educational master's program "Embedded systems for data processing and control" in 09.04.01 "Informatics and computer technology" higher education area

The program is based on the Federal state educational standard for higher education bachelor programs and a general professional cycle of disciplines. The list of questions covers issues common to the related higher education programs and corresponds to the federal state educational standard of higher education.

LIST OF TOPICS:

Discrete mathematics
Set. Subset. Euler-Venn diagrams. Methods for specifying sets. Basic operations on sets. Algebra of sets, its basic formulas. Binary relationships. Images, preimages, inverse mappings, types of mappings. Functions, their properties. Basic equations of combinatorics. Permutations, placements, combinations with and without repetitions. The principle of inclusions and exclusions. Basic concepts of graph theory. Graph (digraph), its elements. Types of graphs. Trees. Rooted graph, binary trees.

Programming Basics Data
Types. Variables (declaration, initialization, assignment). Constants. Special symbols. Scope of variables. Operations (classification, recording features). Loop with a precondition (syntax, operating logic, example). Loop with postcondition (syntax, operating logic, and example).Loop with a parameter (syntax, operating logic, and example). Interchangeability of cycles. Subroutines (syntax, types of subroutines, formal and actual parameters, order of actions when calling a function, context, example). Return operator. Function prototypes (concept, purpose, methods of application). Methods of passing parameters to functions. Methods of passing value from one Machine functions to another. Recursion. Links (concept, methods of application). Pointers (purpose, syntax, operations). Difference between pointers and references.

Data structures
Linear data structures: Array, structure (record) and set – organization and basic operations. Linear data structures: stack, queue and deck – organization and basic operations. Tree data structure: general definition. Binary trees, implementation methods. Graph data structure: definition and implementation methods. Ordered search trees: implementation methods and basic operations.

Algorithms
The concept of algorithm complexity. Algorithm for searching a substring in a string. Boyer-Moore algorithm. Quick sort algorithm (Hoare). Graph traversal algorithms: depth-first search, breadth-first search (wave algorithm). Algorithms for finding the minimum spanning tree of a graph: Prim's algorithm, Kruskal's algorithm. Finding optimal routes on a graph. Dijkstra's algorithm.

Object-Oriented Programming (OOP)
Basic concepts of OOP: inheritance, encapsulation, polymorphism, abstraction. Class declaration and definition. Data members and member functions of a class. Creating class instances, references and pointers to objects. The this pointer. Encapsulation, determination of access rights. Class friends. Static and non-static class members. Default constructors, initialization constructor, initialization list and copy constructor. Destructors — purpose, definition and use. Class templates, parameterization and specialization of class templates.

Computer systems and networks

Basic characteristics of computers. Microprocessors, functional structure. Computer storage devices. Computer peripherals. Computer software. Multi-machine and multi-processor computer systems. Features of computer system architectures. Supercomputer, purpose, main characteristics. Computing cluster, purpose, architectural solutions. Data center, purpose, infrastructure solutions. Computer networks, purpose, existing classifications. Computer network topologies. Addressing system in computer networks. MAC address and its structure. IP address and its structure. Seven-layer OSI model, purpose, interaction of levels of the OSI model. Concepts of protocols and protocol stacks, network protocols, transport protocols, application protocols.

Operating systems (OS)

Purpose and functions of the operating system. Classification of operating systems. The concept of a software interface, its purpose, types of interfaces. Software interrupt and its processing. The concept of the operating environment, composition, purpose. Utilities for extending OS functionality. Concept of task and process. Process dispatching. Process scheduler. Organization of input-output, input-output management. OS functions for memory management. Virtual memory, implementation mechanism. Segmental organization of memory. The mechanism for implementing memory page addressing.

Databases (DB)

Machine Functions of a database management system (DBMS). Stages of database design. Model "Entity-Relationship". Structured data models: hierarchical, network, relational. Relationships and their properties, relationship keys. Normal forms of relationships. Relational algebra. Data types in SQL language. SQL language operators for constructing data manipulation queries. Control constructs in the SQL language, stored procedures, and triggers. Principles of data indexing, recommendations for choosing indexes. SQL statements for creating and dropping indexes. NoSQL databases, basic properties. Unstructured data models: key-value, column family, document, graph. Replication and data fragmentation. The CAP theorem. Architectural solutions for organizing multi-user access to the database. Description of the Client-Server technology. The concept of cloud computing. Transactions transaction properties. Transaction isolation levels. Transaction blocking models.

Basics of artificial intelligence (AI)

Stages of AI development. Turing test. The concept of weak and strong AI. Intelligent information systems. Models of knowledge representation. Expert systems, architecture, examples. Typical tasks of data analysis, their content, characteristics, and examples. Artificial neural networks, neuron model. Known neural network architectures. Training a neural network.